Cerakote™

CERAMIC COATINGS

HIGH TEMP AIR CURE EXHAUST COATINGS

Training Manual

PLEASE READ

Cerakote™ High Temperature Air Cure Exhaust Coatings are designed for professionals and should be applied by NIC -trained applicators and coating professionals with proper training and equipment. This training manual is intended to be used as a supplemental guide for certified and professional applicators **only.** It is critical to follow all instructions in this manual. If for any reason you are not willing to, or cannot follow the steps in this manual, do not attempt to coat any product using Cerakote™, or any other NIC product. If you have any questions please contact NIC Industries.

Thank You.

NIC Industries, Inc.
7050 6th Street
White City Oregon, 97503
(866) 774-7628
www.nicindustries.com

Cerakote™ CERAMIC COATINGS
www.NICINDUSTRIES.com

Phase 1 Surface Preparation

A blasted profile must be applied to the substrate to remove any rust, scale or other coatings. Grit blasting is required to ensure maximum adhesion. Blast the parts with 100 to 120 grit aluminum oxide or garnet sand at 80 to 100 psi. Strive for an even blast pattern over the surfaces of the parts. **Do not use glass beads**, as they dimple the surface rather than etching it, which is required.

Tips:

✓If the part's surface is still shiny after blasting, you haven't blasted enough.
✓ If you use too coarse of grit, the microscopic valleys on the part's surface will be too deep for the 1.0 mil (.001") coating to completely fill while covering the corresponding "peaks" sufficiently to assure a satisfactory coating.
✓ don't use sand that has been previously used to clean dirty, greasy or oily parts.

Pitfalls:

➡If you are using 120 grit, be sure the grit does not wear out as you are using it. 120 grit can wear to an ineffective dust after many uses.
➡Do not touch parts with bare hands, as doing so may leave oily marks which may create defects in the finished coating. **Use latex style gloves for handling blasted parts.**

Phase 2 Racking

Hang or otherwise fixture parts so that you can access all the surfaces of each part with your HVLP spray gun. Metal hooks of different length are ideal for racking exhaust parts. Make sure to rack parts far enough apart so that they will not bump into each other.

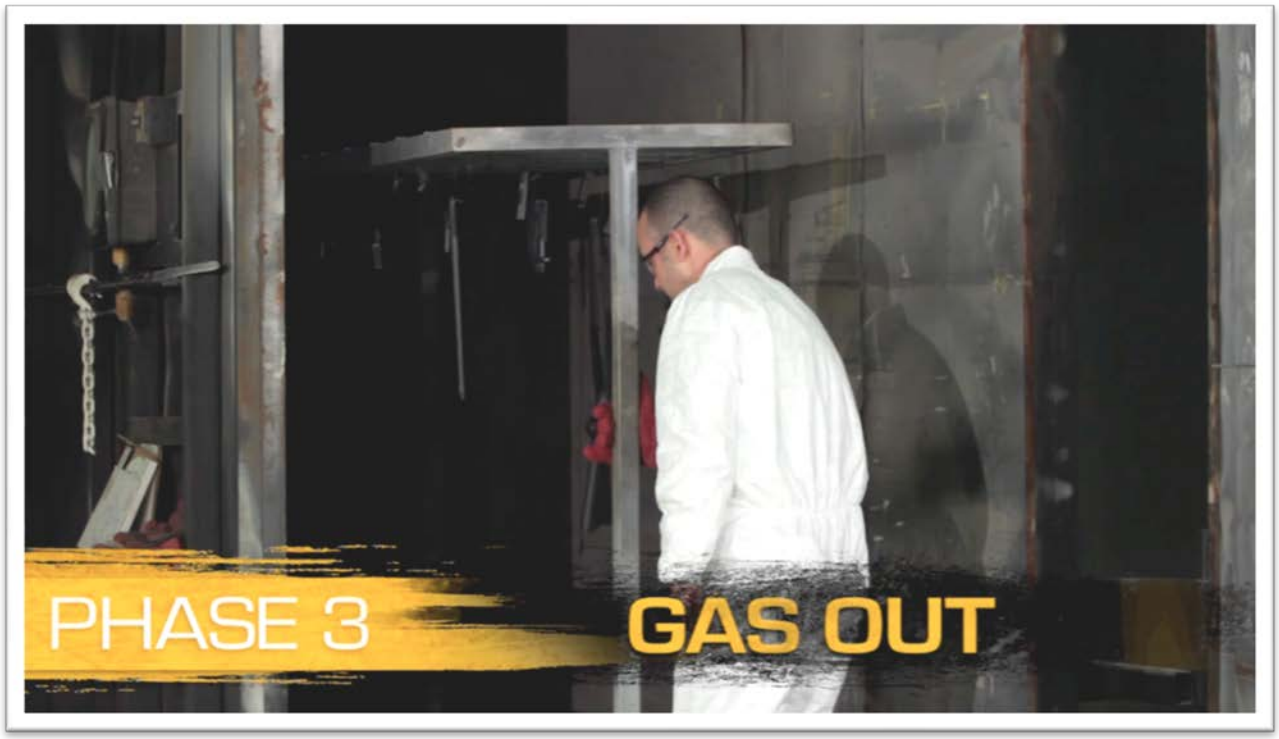
Racking Headers

Racking Exhaust Pipes

Evenly Spaced Parts

Phase 3 Gas Out

It is recommended, but not required to heat the parts in an oven at 250 - 500 degrees Fahrenheit for approximately 30 minutes. This will evaporate and burn off any remaining moisture and oils. Gassing out is typically done when parts are oily. If you are unsure whether or not you should perform the gas out process, please contact NIC for further assistance.



Phase 4 Coating Preparation

Begin by shaking the bottle until the coating is completely mixed and no solids remain in the bottom of the container. Failure to completely disperse the product will result in poor chemical ratios and product failure. Pour the coating through a disposable automotive type paint filter or a reusable filter (shown: NIC Part # SE139). This is done to ensure that no contaminates will be sprayed on the finished product. Clean all containers and equipment with acetone.

Shake

1 

Pour/Filter

2 

Fill HVLP Spray Gun

3 

Clean with Acetone

4 

CHECKLIST BEFORE SPRAYING

✓ Ensure all parts to be coated are hung securely, ensuring parts do not touch anything during the application process.
✓Spray in a well-ventilated area, wear a respirator, protective gloves and safety glasses.
✓MSDS's and additional safety & handling information are available at www.nicindustries.com

Suggested Equipment

IWATA LPH-80
Detail Spray Gun
NIC: Part # NIC SE 138

· Features adjustable spray pattern from round to full fan shape
· A stainless-steel nozzle, paint passage and heat tempered needle ensure long- lasting, peak performance spraying
· Uses the reliable and easy-to-service cartridge-style "air-valve" set, which can be serviced outside the gun and easily placed back into the gun body
· Its 4 oz. (110 ml) stainless-steel gravity cup is center-mounted and rotates, allowing for spraying horizontally, vertically or underneath surfaces
· Unlike siphon-feed guns, this gravity-feed cup will work with small amounts of paint without spitting
· Spray pattern is from 1/8" to 6" (0.3 cm to 15.24 cm)

Phase 5 Spraying

Pour the Cerakote into an HVLP gun with a .8mm tip (NIC Part# SE 138). 20 to 25 PSI is the recommended air pressure for spraying Cerakote.

PRACTICE:

Start spraying on a piece of white paper to adjust the spray pattern and practice your spraying technique. Spray with the gun 3 to 5 inches away from the paper and adjust the spray pattern to between 2 and 3 inches wide.

Phase 5 Spraying (.cont)

Blow off Parts with dry compressed air to make sure there is no trapped blasting media in holes or pockets. Sand or other media left behind will cause surface defects.

Start spraying in the most difficult area of each part, then progress and finish to the easier areas. This should help avoid runs and thin spots. When spraying, strive for even coverage. You are seeking a .001 - .002 thousandth coating thickness. Spray with sufficient volume so that the Cerakote doesn't dry spray, which is when the coating dries in the air before reaching the part.

TIP:

When spraying, the part should appear wet but not so wet that it wants to run.

Phase 6 Curing

Allow parts to air cure. Parts will be tack free after approximately 35 minutes and can be packaged or installed the same day.

Cerakote will reach full cure in five days. Prior to full cure, parts should be handled with care, however you do not need to wait the full five days for packaging, installation or use.

CERAKOTE™ HIGH TEMPERATURE TRAINING PROGRAM

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Cerakote™ offers the only one on one training program for high temperature ceramic coatings. Cerakote™ Courses are custom designed to meet each customers learning objectives. With individual training, our instructors are able to speak with students prior to training course and custom design each class to meet the specific needs of each customer, Customers can apply any of Cerakote's™ industry leading ceramic coatings on their own parts or those supplied by Cerakote™. Courses are taught at Cerakote's™ Training Facility in White City Oregon or onsite (*) While every class is custom tailored to meet each customers's needs, below are topics typically covered in most courses.

TRAINING TOPICS

- Metal Prep.
- Out- gassing.
- Racking Techniques.
- Choosing the coating for the right application.
- Proper curing techniques and schedules.
- Problem solving and troubleshooting defects.
- Proper equipment and operation.
- Re-works.

(*) Contact NIC for further information about on-sight training

CERAKOTE™ HIGH TEMPERATURE TRAINING PROGRAM

Class Location

NIC Industries, Inc is located at 7050 6th Street, White City OR 97503.White City is located in Southern Oregon approximately 5 miles from Medford Oregon and approximately 280 miles from Portland Oregon.

Transportation

Rogue Valley International Airport (MFR) is located 6 miles from NIC and provides daily flights from several major west coast airports. All major rental car companies are located at the Rogue Valley International Airport.

Lodging

NIC has negotiated discounted rates with several hotels in close proximity to our facility. Information on lodging can be found at http://www.nicindustries.com/downloads.php

TECHNICAL REPORT

Cerakote™
CERAMIC COATINGS

HIGH TEMP AIR CURE EXHAUST COATINGS

CERAKOTE™ Exhaust Coatings

The unique, ceramic-based formulation used in the entire line of Cerakote™ exhaust coatings enhances a number of physical characteristics. Cerakote™ exhaust coatings are durable, heat-resistant coatings with excellent long-term performance. Additionally, Cerakote™ ceramic exhaust coatings function as thermal barriers for thermally-sensitive applications. This report outlines the different high-temperature coatings available from Cerakote™ and discusses the properties inherent to each. The thermal barrier capability and chemical resistance of each coating was also studied, and the results of this study are published in this paper.

Background

Unlike other "ceramic" coatings, Cerakote™ is formulated from the molecular level. All Cerakote™ products begin with a liquid resin, and during the cure process, the resin forms a 3-D ceramic matrix. Additional property-enhancing materials are combined with the raw resin and trapped within the matrix. This technology creates a durable, heat resistant coating and makes Cerakote™ the premier exhaust coating available on the market today.

Cerakote™ offers four different types of high-temperature products. An outline of each of these coatings is shown below in table 1. As shown, Cerakote™ exhaust coatings are available in both ambient-cure and oven cure systems. Each of the coatings may be used over a number of different substrates, including steel and aluminum. MC-Series is also commonly used over chrome plating, PVD surfaces, and some types of powder coating for additional protection and to prevent "rain-bowing" due to excessive heat. The average coating thickness ranges from 0.5 -1.0 mil and can be used in areas of low tolerance. These coatings are also VOC exempt in all 50 states and in the South Coast region of California.

Table 1. Characteristics of different high-temperature Cerakote™ exhaust coatings.

Type of Cerakote™	Cure Schedule	General Appearance
C-Series	Ambient cure; Dry to touch; 45 min	Various Satin Colors
MC-Series	Ambient Cure; Dry-to-touch; 45 min	Clear
W-Series	500°F, 1 hr	Chrome-like
V-Series	500°F, 1 hr	Various Satin Colors

Thermal Barrier Testing

Four different Cerakote™ products were tested to determine the potential of each as a thermal-barrier coating. These four coatings are shown in table 2 with their respective properties. Each of these coatings were used to coat a 3' long section of pipe. The pipes were manufactured of cold-rolled steel and had an inner diameter of 2". The pipes were cured according to the appropriate cure schedule and then horizontally mounted using 2 clamps spaced 6" from the center of each pipe. Three thermocouples, one in the center, one 3" from the inlet and one 3" from the outlet, were positioned on each pipe. Each thermocouple was held in place using a band clamp. A gas burner was attached to the inlet side of each pipe and the pipes were heated according to the following program:

Start condition: Ambient air at 100 SCFM
Ramp to 572°F in 1 minute, hold for 10 minutes
Ramp to 1112°F in 1 minute, hold for 10 minutes

Ramp to 1706°F in 1 minute, hold for 10 minutes, and the air flow rate was maintained at 100 SCFM for the duration of the test. The inlet gas temperature and the temperatures recorded by the 3 skin thermocouples were also monitored and recorded at 1 second intervals. The results of this test are illustrated in figure 1 and further explained in table 3. At temperatures below 572°F, C-7300 Black Velvet performed the best. Above 572°F V-171 Turbine Coat provided the most thermal protection. At 572°F, using C-7300 Black Velvet as a thermal barrier resulted in a 110°F drop in outer skin temperature. At 1112°F and 1706°F, V-171 Turbine Coat resulted in a 102°F and 185°F drop, respectively. Afterward, the pipes were examined in order to assess any deterioration in the physical or visual properties. C-186, C-7300, and V-171 maintained adhesion of 5B as well as color and gloss. W-207/W-350 showed a slight loss in adhesion and gloss. This can potentially be prevented by coating the inside of the pipe
with V-171 turbine coat.

Table 2. Physical properties of four different CerakoteTM coatings tested for thermal barrier properties.

Type of Cerakote™	Adhesion ASTM D3359	Scratch Hardness/Hardness ASTM D3363	Impact ASTM 2794	Mandrel Bend ASTM D522
C-186 Piston Coat	5B	5h/9h	40/20 inch-lbs	4 mm at 180° rotation
C-7300 Black Velvet	5B	6h/7h	40/20 inch-lbs	2 mm at 180° rotation
W-207/W-350 Chromex/ Base Coat	5B	2b/9h	100/40 inch-lbs	0 mm at 180° rotation
V-171 Turbine Coat	4B	4h/5h	60/20 inch-lbs	1 mm at 180° rotation

Figure 1

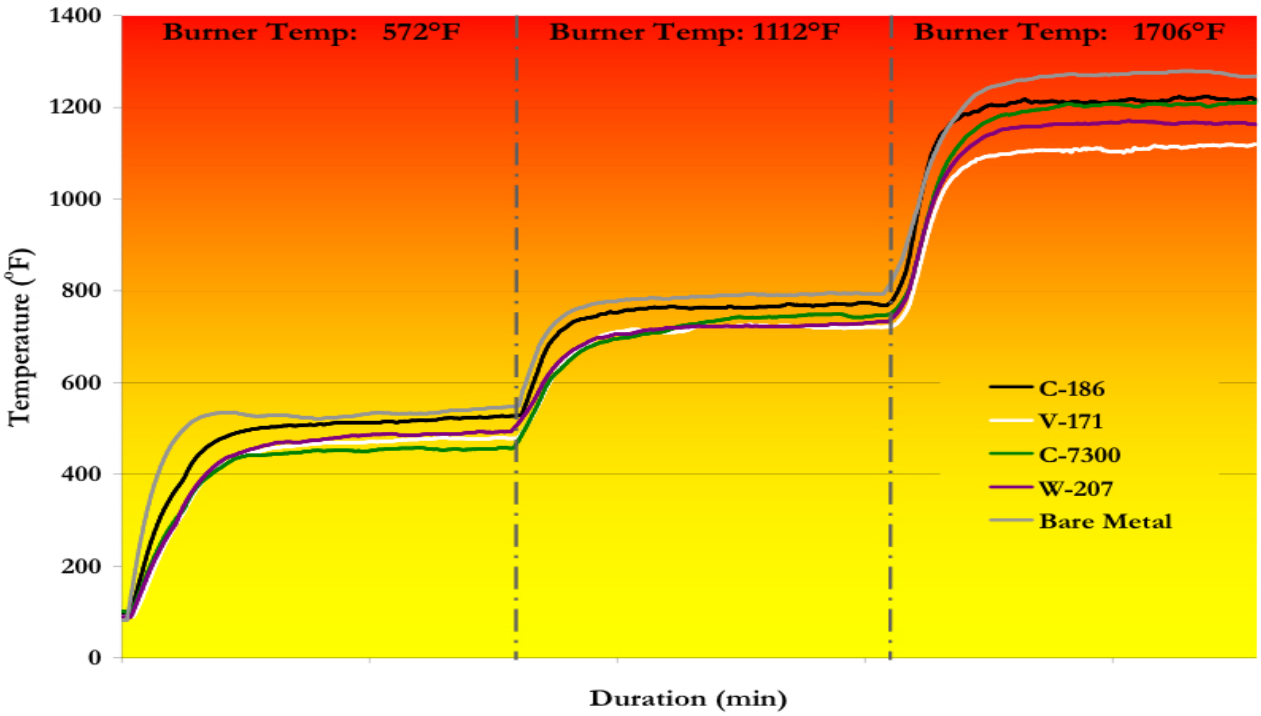

Figure 1. Outer skin temperature profile for 4 pipes coated with Cerakote™ and one uncoated, cold-rolled steel pipe over the temperature range ambient- 1706^{0}F

Table 3. Temperature difference on outer skin of Cerakote™ coated pipe as compared to bare metal pipe.

Cerakote™	Temperature Drop (°F) At 572°F	Temperature Drop (°F) At 1112°F	Temperature Drop (°F) At 1706°F
C-186 Piston Coat	48	55	81
C-7300 Black Velvet	110	77	91
W-207/W-350 Chromex/ Base Coat	77	90	135
V-171 Turbine Coat	88	102	185

Chemical Resistance

The ability of Cerakote™ exhaust coatings to resist chemical breakdown was tested by dipping coated panels into a series of solvents and allowed to sit for 24 hours. Afterward, the samples were removed, analyzed and assigned a rank depending on the resistance to each specific chemical. The results of this test are shown in table 4. The performance of Cerakote™ C-186, C-7300, and V-171 was classified as excellent for the solvent tests. This indicates that the coating was not affected following a 24-hour immersion in the solvents. Cerakote™ W-207/W-350 performed excellent in 9 of the solvents and performed fair to good in the remaining solvents.

Table 4. Chemical resistance of Cerakote™ C-186, C-7300, W-207/W-350, and V-171 to 13 different solvents

Solvent	Cerakote™ C-186	Cerakote™ C-7300	Cerakote™ W-207/W-350	Cerakote™ V-171
WD-40	★★★★	★★★★	★★★★	★★★★
Motor Oil	★★★★	★★★★	★★★★	★★★★
Lacquer Thinner	★★★★	★★★★	★★★	★★★★
Mineral Spirits	★★★★	★★★★	★★★★	★★★★
Methyl Ethyl Ketone	★★★★	★★★★	★★★	★★★★
Gasoline	★★★★	★★★★	★★★★	★★★★
Diesel	★★★★	★★★★	★★★★	★★★★
Graffiti Remover	★★★★	★★★★	★★	★★★★
Brake Cleaner	★★★★	★★★★	★★★★	★★★★
Denatured Alcohol	★★★★	★★★★	★★★★	★★★★
Paint Stripper	★★★★	★★★★	★★★★	★★★★
Acetone	★★★★	★★★★	★★★★	★★★★
Ammonia	★★★★	★★★★	★★★	★★★★

★★★★ = excellent chemical resistance ★★★ = good chemical resistance
★★ = fair chemical resistance ★ = poor chemical resistance

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NIC Industries, Inc.
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White City, Oregon, 97503
Toll Free: (866) 774-7628
Phone: (541) 826- 1922
Email: info@nicindustries.com
Website: www.nicindustries.com
Fax: (541)826-6372

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NIC Industries, Inc.
7050 6th St
White City, Oregon, 97503
Phone:(541) 826 -1922
Toll Free: (866) 774 - 7628
Email: info@nicindustries.com
Website:www.nicindustries.com
Fax:(541) 826 - 6372